DEVICE FOR PRODUCING EXPANDED FLAT MATERIAL

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a National Stage entry under 35 U.S.C. §371 of International Application PCT/AT2003/000194, which was filed on July 10, 2003, the disclosure of which is expressly incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention generally relates to a device for producing expanded flat material, and, more particularly, to a device comprising a cutting and expanding device and a coiling device. The starting material is a foil web that is guided between cutting rollers supported one above the other, formed of individual upper smooth cutting knives and lower cutting knives forming the cut length through recesses alternately in the cutting area. The expanding device includes pairs of toothed belts, or similar conveyor elements, guided over partially driven deflection rollers. The conveyor elements hold the foil web at the edges and make it advance.

2. Discussion of Background Information

[0003] A device is known from US Pat. No. 4,102,024 that relates to the production of expanded material. A large number of punch knives are pressed onto the foil web and are simultaneously guided gradually outwards so that an expanded strip is produced. A guide wheel is used to center the expanded strip. A drawback of this device is that a lateral hold is not given and thus flat layers cannot be obtained due to the length differences with the edges.

[0004] Furthermore, US Pat. No. 4,486,927 discloses a device for producing expanded material in which cutting rollers are used to achieve the perforation. An expanding device presses the foil web gradually downwards with a number of expanding wheels so that a V-shaped expanded strip is formed. A flat material strip cannot be produced with this device, either.

[0005] According to European Pat. Appln. No. EP 0 669 176, a method and a device for producing dimensionally stable spherical bodies are proposed in which an expanding device is provided to form a foil web into an expanded strip. A corresponding upper and lower toothed belt pair is used, which holds the foil web at the edges and transports it. A bow directed upwards is provided between the belt pairs, which bow renders possible the expansion of the foil web. Since such an expansion bow has the disadvantage of producing dust particles through friction, there has now been a change to using a moveable roller in place of the expansion bow.

[0006] In order to obtain a uniform expansion, the roller has been embodied as split and axially adjustable. One drawback was discovered to be that, although the friction dust particles were reduced, unevennesses occurred in the center of the expanded strip. That is, it was difficult to achieve a uniform embodiment of the expanded strip over the entire width.

[0007] Furthermore, similar devices are shown by patents US Pat. No. 4,621,397 A, US Pat. No. 4,305,187 A and US Pat. No. 5,088,170 A, but they do not relate to the subject matter of this application.

SUMMARY OF THE INVENTION

[0008] In light of such disadvantages of the prior art, the present invention provides a device for producing flat expanded material that contains an expanding device that gives the expanded strip a uniform structure over the entire width. According to the invention, the expanding device on both sides of the foil web has respectively one toothed belt pair that guides the foil web vertically upwards with one lateral edge, starting from the horizontal plane, via hinged, optionally rigid, sliding blocks arranged in the interior area of the toothed belts. The other lateral edge of the foil web is guided vertically downwards in the same manner, i.e., forming a scissor movement, and an expansion of the foil web is formed across the resulting diagonal.

[0009] It is thus achieved that a flat expanded strip can be produced that is free from internal tensions.

[0010] It is advantageous if the sliding blocks have hinges and these are adjustable in height. Different expansion widths can thus be adjusted.

[0011] It is also advantageous if the upper sliding block is embodied to be vertically displaceable to the inside of the toothed belt. As such, it is possible to take into consideration the material strength of the expanded strip.

[0012] It is also advantageous if the sliding surfaces of the upper sliding block and of the lower sliding block are embodied with equidistant spacing as flat planes, or optionally with surfaces provided with a radius, which form a gradual transition into the expanded position t produce the foil web. In this manner, the toothed belts hold the edge of the foil web over the entire length.

[0013] According to a first aspect of the invention, there is a device for producing expanded flat material, the device comprising a first conveyor structured and arranged to guide a first lateral edge of a web vertically upward with respect to a horizontal plane, and a second conveyor structured and arranged to guide a second lateral edge of the web vertically downward with respect to the horizontal plane. A spacing between the first conveyor and the second conveyor increases in a direction of advancement of the web.

[0014] The device may further comprise a cutting device, a coiling device, and an expanding device that includes the first conveyor and the second conveyor. The web may comprise a foil web. Moreover, the cutting device may comprise cutting rollers supported one above the other, upper smooth cutting knives, lower cutting knives, and recesses such that the web is structured and arranged to be guided through the cutting rollers.

[0015] In embodiments, the first conveyor may comprise a first toothed belt pair, and the second conveyor comprises a second toothed belt pair. Furthermore, the first toothed belt pair and the second toothed belt pair may be guided over deflection rollers. At least one of the deflection rollers may comprises a drive roller. In implementations, the first toothed belt pair holds the first lateral edge using first teeth, and the second toothed belt pair holds the second lateral edge using second teeth.

[0016] The device may further comprising a first sliding block guiding the first toothed belt pair, and a second sliding block guiding the second toothed belt pair. The first sliding block may be arranged in an interior area of the first toothed belt pair and the second toothed belt pair. Additionally, the web may comprise a foil web such that as the spacing between the first conveyor and the second conveyor increases in the direction of advancement, the foil web is expandable across a diagonal extending from the first lateral edge to the second lateral edge.

[0017] The first sliding block and the second sliding block may comprise hinges. Also, the first sliding block and the second sliding block may be adjustable in height. Furthermore, the first sliding block may be vertically displaceable to inside the first toothed belt pair.

[0018] In embodiments, the first sliding block comprises a first flat-plane sliding surface, the second sliding block comprises a second flat-plane sliding surface, and the first flat-plane sliding surface and the second flat-plane sliding surface are structured and arranged to expand the web by gradually increasing the spacing between the first conveyor and the second conveyor in the direction of advancement.

[0019] Alternatively, the first sliding block may comprise a first sliding surface having a first radius, the second sliding block may comprise a second sliding surface having a second radius, and the first sliding surface and the second sliding surface may be structured and arranged to expand the web by gradually increasing the spacing between the first conveyor and the second conveyor in the direction of advancement.

[0020] According to another aspect of the invention there is an apparatus comprising a first belt pair structured and arranged to hold a first lateral edge of a web between first teeth, and a second belt pair structured and arranged to hold a second lateral edge of the web between second teeth. The apparatus also comprises first deflection rollers and a first slide block that guide the first belt pair to a vertically upward position with respect to a horizontal starting position, and second deflection rollers and a second slide block that guide the second belt pair to a vertically downward position with respect to the horizontal starting position. The web is expandable between the first lateral edge and the second lateral edge along a diagonal between the vertically upward position and the vertically downward position. The web may comprise a

foil web and the apparatus may further comprise cutting rollers having cutting knives for passing the foil web through to form cuts in the foil web, at least one drive element driving the first belt pair and the second belt pair, and a coiling device.

[0021] According to a third aspect of the invention, there is a method, comprising gripping a first lateral edge of a foil web and gripping a second lateral edge of the foil web. The method also includes expanding the foil web between the first lateral edge and the second lateral edge by guiding the first lateral edge vertically upward from a horizontal starting plane while guiding the second lateral edge vertically downward from the horizontal starting plane. the method may further comprise cutting portions of the foil web between the first lateral edge and the second lateral edge before the expanding, and coiling the foil web after the expanding.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The invention will be explained in more detail on the basis of exemplary embodiments, in which:

[0023] Fig. 1 shows a device in side view with an expanding device;

[0024] Fig. 2 shows a front view of the expanding device (section A – A);

[0025] Fig. 3 shows a variant of the expanding device; and

[0026] Fig. 4 shows an embodiment of the toothed belts (detail B).

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0027] Fig. 1 shows in diagrammatic form a device for producing expanded strips in which the expanding device 10 according to aspects of the invention is arranged. From a supply drum 2, on which a foil web 1 is wound as starting material, the foil web 1 is guided to the cutting device 3. This cutting device 3 is essentially composed of an upper cutting roller 4 and a lower cutting roller 5 supported one above the other. The upper cutting roller 4 is embodied as a smooth roller with cutting elements, while the lower roller 5 features corresponding recesses in the cutting area forming the cut length. After the foil web 1 has been given slots at regular

intervals while running through the cutting device 3, it is guided to a tensioning device 6. The tensioning device 6 has a deflection roller 7 arranged at the start, the foil web 1 being brought downwards to a tensioning roller 9 and subsequently upwards by deflection roller 8 into the horizontal position again. The foil web 1 is then guided into the expanding device 10.

[0028] The expanding device 10 contains on each side essentially one toothed belt pair 18, 19 that is guided over a number of deflection rollers 11 through 17 and is positioned at the edges of the foil web 1. The upper toothed belt 18 is guided around the deflection rollers 11, 13 and 15. The teeth of the toothed belt side 20 point outwards, while, in contrast, the toothed belt side 21 is smooth and rests on the inside. Likewise, the lower toothed belt 19 is guided over the deflection rollers 12, 14 and 16, 17. Here too, the toothed belt 19 is toothed towards the outside, while the inside is embodied to be smooth. The toothed belt pairs 18, 19 are engaged between the deflection rollers 11, 12 and 13, 14 and hold the foil web 1 firmly at the edges. Toothed chains or similar conveyor elements can also be used in place of the toothed belts. In the center of the expanding device 10 are an upper sliding block 22 and a lower sliding block 23. The upper sliding block 22 has a guide that with a flat plane, optionally a radius R, guides the edge of the foil web 1 from the deflection roller 11 to the deflection roller 13.

[0029] The guide is also present at equidistant spacing in the lower sliding block 23, such that the two toothed belts 18, 19 are engaged and the edge of the foil web 1 lies between them. One of the deflection rollers, e.g., 11, is embodied as a drive roller.

[0030] Advantageously, the lower deflection roller 12 is also embodied as a drive roller in order to ensure a uniform pull of the belt pairs 18, 19. In embodiments, the upper sliding block 22 has an adjusting device 24 so as to be able to align it vertically to the inside of the toothed belt 18 and to vary the contact pressure.

[0031] The lower toothed belt 19 runs over the deflection roller 12, which can be embodied as a drive roller, and is guided over the deflection rollers 14, 16, 17. However, it is also possible to transmit the drive via a pinion 33 to the toothed belt side 20. In this manner, only one drive train is needed. In the area of the upper sliding block 22, the lower sliding block 23 is rigidly attached to the machine frame.

[0032] On the opposite side of the expanding device 10–shown by a broken line in the drawing for reasons of clarity—in the same way as described above, an other toothed belt pair 18,19 is arranged that engages at the other edge of the other side of the foil web 1. However, a difference is that this other edge of the foil web 1 is guided downwards. Although the arrangement of the deflection rollers is the same, it is turned upside down. The same applies to the sliding blocks 22, 23. At the entrance to the expanding device 10, the foil web 1 is flat, is gripped by toothed belts 18, 19, and is guided upwards by one side through the sliding blocks 22, 23 and the arrangement of the deflection rollers 13, 14. On the opposite side, the toothed belt pair 18, 19 is guided downwards by the position of the deflection rollers 31, 32. Through the engagement of the toothed belt pairs 18, 19, a tooth-like profile is produced on the edges, which during the lateral stretching of the foil web 1 equalizes the length change during the expansion and thus produces a flat expanded strip. The expanded foil web 1a guided out of the expanding device 10 comes onto a deflection 25 that is composed of a smooth roller pair 26, 27 supported one above the other. In this manner, the residual tensions are eliminated. Subsequently, the expanded foil web 1a comes onto a take-up roller 28.

[0033] The front view of the expanding device 10 is shown in Fig. 2 according to section A – A of Fig. 1. In the center is the foil web 1 as it is inserted into the expanding device 10. Through the arrangement of the toothed belt pairs 18, 19, the deflection rollers, and the sliding blocks 22, 23, one edge of the foil web 1 is pressed upwards, while an other edge is, in the same way, brought downwards. The slots made in the foil web 1 are widened through this change in width. Advantageously, this expansion is 5-fold, preferably 3-fold the original width. This depends primarily on the material consistency, but also on the selected cut length of the foil web 1. The deflection rollers 13, 14, 17 and the sliding blocks 22, 23 are arranged to guide the one edge of the foil web 1 upwards, while the deflection rollers 31, 32 are used for guiding the other edge downwards.

[0034] Fig. 3 shows a variant of the expanding device 10, the sliding blocks 30 of which are embodied to be moveable by a hinge 29 according to the arrows shown in the figure. As such, the sliding blocks 30 can adapt well to the guiding of the toothed belt pairs 18, 19. Otherwise, the same reference numbers apply for the deflection rollers as already mentioned in Fig. 1. The

deflection rollers 11, 13, 15 are responsible for the upper toothed belt 18, while the deflection rollers for the lower toothed belt 19 have the reference numbers 12, 14, 16 and 17 seen in the direction of movement. The same applies to the other side that then runs over the deflection rollers 31, 32 for the edge guided downwards. Here too the other side of the expanding device is shown by a broken line.

[0035] Fig. 4 shows an embodiment and position of the toothed belts 18, 19, which are labeled B in Fig. 1. The teeth are in mutual engagement and between them lies the foil web 1, which takes on the toothed shape. The outer sides of the toothed belts 18, 19 are provided with smooth toothed belt side 21.

[0036] An advantage of this expanding device 10 lies in that this is simple in construction, can be variably adjusted and moreover produces a uniform structure over the entire width of the expanded foil web 1a. This is a prerequisite for the versatile use of such expanded strips.